

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (cancelled)
2. (currently amended) ~~The regulator of claim 1 further comprising A series connected buck-boost regulator comprising:~~
a control circuit;
a switching circuit for connecting to a source voltage;
an output circuit connected to said switching circuit and for outputting a load voltage,
wherein
said control circuit controls said output circuit and said input circuit for operating said
regulator in a plurality of modes including:
a current limiting (CL) mode;
a buck mode; and
a boost mode,
wherein only a fraction of an output power of said regulator is switched by said
switching circuit during one or both of the buck and the boost modes;
and
a transformer having a primary winding and a center-tapped secondary winding,
wherein the center tap of said secondary winding is for connecting to the
source voltage, and wherein said primary winding is connected to said
switching circuit, and further wherein said secondary winding is connected to
said output circuit.
3. (currently amended) ~~The regulator of claim 1, A series connected buck-boost~~
~~regulator comprising:~~
a control circuit;
a switching circuit for connecting to a source voltage;
an output circuit connected to said switching circuit and for outputting a load voltage,
wherein
said control circuit controls said output circuit and said input circuit for operating said
regulator in a plurality of modes including:
a current limiting (CL) mode;

a buck mode; and

a boost mode,

wherein only a fraction of an output power of said regulator is switched by

said switching circuit during one or both of the buck and the boost
modes;

and wherein said switching circuit includes a first switch, a second switch, a
third switch, and a fourth switch in a bridge configuration, and further
wherein said output circuit includes a series connected fifth and sixth
switch connected to a series connected seventh and eighth switch.

4. (original) The regulator of claim 3, wherein, during said boost mode, said control circuit continuously turns on said fifth switch and said sixth switch, and further wherein said control circuit cycles through a plurality of boost states including:

a first boost state wherein the first, fourth, and seventh switches are on and further wherein the second, third, and eighth switches are off;

a second boost state wherein the seventh and eighth switches are on, and further wherein the first, second, third, and fourth switches are off; and

a third boost state wherein the second, third and eighth switches are on and further wherein the first, fourth, and seventh switches are off.

5. (original) The regulator of claim 3, wherein, during said buck mode, said control circuit continuously turns on said seventh switch and said eighth switch, and further wherein said control circuit cycles through a plurality of buck states including:

a first buck state wherein said first, fourth, and sixth switches are on and further wherein said second, third, and fifth switches are off;

a second buck state wherein said fifth and sixth switches are on, and further wherein said first, second, third, and fourth switches are off; and

a third buck state wherein said second, third, and fifth switches are on, and further wherein said first, fourth, and sixth switches are off.

6. (original) The regulator of claim 3, wherein, during said current limiting mode, said control circuit continuously turns off said first, second, third, and fourth switches, and further wherein said control circuit cycles through a plurality of CL states including:

a first CL state wherein said fifth, sixth, seventh, and eighth switches are on; and

a second CL state wherein said fifth, sixth, seventh, and eighth switches are off.

7. (original) The regulator of claim 3, further comprising a ninth switch connected to said secondary winding which is turned off by said control circuit during said boost and said

buck modes, but is turned on during said CURRENT LIMITING mode to short out said secondary winding.

8. (original) The regulator of claim 3, wherein each switch has a diode placed in parallel.

9. (original) The regulator of claim 8, further comprising:
a ninth switch connected to said center tap of said secondary winding which is turned off by said control circuit during said boost and said buck modes, but is turned on during said CURRENT LIMITING mode to short out said secondary winding;
a freewheeling diode connected between said output circuit and a ground;
a first transformer diode connecting a terminal of said secondary to said ninth switch;
a second transformer diode connecting another terminal of said secondary to said ninth switch; and
an inductor for connecting said output circuit to a load.

10. (original) The regulator of claim 9, wherein, during said boost mode, said control circuit continuously turns on said fifth switch and said sixth switch, and continuously turns off said ninth switch, and further wherein said control circuit cycles through a plurality of boost states including:

a first boost state wherein the first, fourth, and seventh switches are on and further wherein the second, third, and eighth switches are off;
a second boost state wherein the seventh and eighth switches are on, and further wherein the first, second, third, and fourth switches are off;
and

a third boost state wherein the second, third and eighth switches are on and further wherein the first, fourth, and seventh switches are off;

and wherein, during said buck mode, said control circuit continuously turns on said seventh switch and said eighth switch, and continuously turns off said ninth switch, and further wherein said control circuit cycles through a plurality of buck states including:

a first buck state wherein said first, fourth, and sixth switches are on and further wherein said second, third, and fifth switches are off;
a second buck state wherein said fifth and sixth switches are on, and further wherein said first, second, third, and fourth switches are off; and
a third buck state wherein said second, third, and fifth switches are on, and further wherein said first, fourth, and sixth switches are off;

and further wherein, during said CURRENT LIMITING mode, said control circuit continuously turns off said first, second, third, and fourth switches, and continuously turns on said ninth switch, and further wherein said control circuit cycles through a plurality of CL states including:
a first CL state wherein said fifth, sixth, seventh, and eighth switches are on;
and
a second CL state wherein said fifth, sixth, seventh, and eighth switches are off.

11. (currently amended) ~~The regulator of claim 1, further comprising~~ A series connected buck-boost regulator comprising:

a control circuit;
a switching circuit for connecting to a source voltage;
an output circuit connected to said switching circuit and for outputting a load voltage,
wherein
said control circuit controls said output circuit and said input circuit for operating said regulator in a plurality of modes including:
a current limiting (CL) mode;
a buck mode; and
a boost mode,
wherein only a fraction of an output power of said regulator is switched by
said switching circuit during one or both of the buck and the boost
modes;
and
a transformer having a primary winding and a center-tapped secondary
winding, with the center tap for connecting to the source voltage,
wherein
said switching circuit includes a first switch, a second switch, a third switch, and a
fourth switch in a bridge configuration, said primary winding of said
transformer connected to a center of said bridge, and further wherein
said output circuit includes a series connected fifth and sixth switch connected to a
terminal of said secondary winding and connected to a series connected
seventh and eighth switch connected to another terminal of said secondary
winding, and also wherein
a ninth switch is included in said regulator for shorting out said transformer secondary
winding on command from said control circuit.

12. (original) The regulator of claim 11, wherein, during said boost mode, said control circuit continuously turns on said fifth switch and said sixth switch, and continuously turns off said ninth switch, and further wherein said control circuit cycles through a plurality of boost states including:

a first boost state wherein the first, fourth, and seventh switches are on and further wherein the second, third, and eighth switches are off;

a second boost state wherein the seventh and eighth switches are on, and further wherein the first, second, third, and fourth switches are off; and

a third boost state wherein the second, third and eighth switches are on and further wherein the first, fourth, and seventh switches are off;

and wherein, during said buck mode, said control circuit continuously turns on said seventh switch and said eighth switch, and continuously turns off said ninth switch, and further wherein said control circuit cycles through a plurality of buck states including:

a first buck state wherein said first, fourth, and sixth switches are on and further wherein said second, third, and fifth switches are off;

a second buck state wherein said fifth and sixth switches are on, and further wherein said first, second, third, and fourth switches are off; and

a third buck state wherein said second, third, and fifth switches are on, and further wherein said first, fourth, and sixth switches are off;

and further wherein, during said CURRENT LIMITING mode, said control circuit continuously turns off said first, second, third, and fourth switches, and continuously turns on said ninth switch, and further wherein said control circuit cycles through a plurality of CL states including:

a first CL state wherein said fifth, sixth, seventh, and eighth switches are on; and

a second CL state wherein said fifth, sixth, seventh, and eighth switches are off.

13-20. (cancelled)